which fortunately is plentiful, as it will not be possible to receive further supplies of specimens from India. The flora is so clear and well arranged that it ought to prove of great value in Madras.

A Complete Course of Volumetric Analysis for Middle and Higher Forms of Schools. By W. T. Boone. Pp. viii+164. (London: Blackie and Son, Ltd., 1918.) Price 3*s.* 6*d.* net.

IT is generally recognised that a well-planned course of chemical analysis by volumetric processes provides good intellectual and manipulative training in scientific methods. Careful thought, clear reasoning, and habits of accuracy are fostered by it. One may hope, indeed, that the time is not far distant when all students in our public schools, whether on the "classical" or on the "modern" side, will receive some such training as a normal part of their education, apart altogether from any question of a contemplated career in chemistry.

For such a course Mr. Boone's little book supplies an excellent basis. It "begins at the beginning," and leads the student on by easy but educative stages to quite advanced work. The numerous exercises are very well devised, and ample directions and explanations are given. A useful feature is the interspersed questions on points suggested by the experiments: they focus the learner's attention on matters of special importance. The experiments include the preparation of indicators and standard solutions, as well as analytical exercises; and there is a chapter, short and sufficiently simple, explaining the behaviour of indicators on the usual theory of ionic dissociation. The book can be confidently recommended.

C. S.

The Statesman's Year Book, 1918. Edited by Sir J. Scott Keltie, assisted by Dr. M. Epstein. Pp. xlviii+1488. (London: Macmillan and Co., Ltd., 1918.) Price 18*s.* net.

THIS ever-welcome annual contains the usual familiar features. The bibliographies have been brought, so far as is possible, up to date. Some of this statistical material "cannot be given," other parts are "provisional," for obvious reasons; but an effort has been made to cope with the abnormal conditions. A notable conspectus of the world's pre-war traffic in foodstuffs is provided in a folding map showing relative exports and imports. From an inset diagram we learn that the United States food production just equalled the requirements of the country; only Russia, Canada, and Argentina produced an excess; while the United Kingdom provided for just above half the required quantities of foodstuffs; though Canada is given, Australia is omitted. Among the introductory tables we note one dealing with sugar. During the war the world's supply of sugar has decreased by 20 per cent.; the production of sugar from the sugar-beet declined by more than 40 per cent., that from the cane has grown by 20 per cent., the output from Java having increased by 40 per cent.

LETTERS TO THE EDITOR.

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Auroral Observations in the Antarctic.

IN NATURE for April 11 last Dr. Chree reviewed Sir Douglas Mawson's paper on "Auroral Observations at the Cape Royds Station, Antarctica," and directed attention to the impression the observers received that the aurora was sometimes seen in the lower atmosphere between them and Mount Erebus. A similar statement had appeared in Shackleton's book, "The Heart of the Antarctic" (vol. ii., pp. 360–61), before Scott's expedition left for the South. As this subject is of fundamental importance in all discussions of the origin and nature of the aurora, I arranged with all members of the expedition that I should be called whenever they saw, or thought they saw, an aurora in front of Erebus.

Observations of this phenomenon were made on three occasions, and luckily I was at hand each time. I reproduce here, verbatim, the notes I made immediately after each occurrence:—

"(*a*) *May* 21, 1911.—This evening there was a bright aurora, and word came in to me that the aurora beams were clearly visible between here and Erebus. On going out it appeared for some moments that this was so, but on looking closely I came to the conclusion that the effect was an illusion. The moon was low in the south, and only one or two shoulders of Erebus were lit up by it; these, however, formed more or less clear bands of light from top to bottom of the mountain. When the aurora was bright above the mountain these moonlight bands appeared as continuations of the aurora beams, and it was quite easy to imagine them in motion owing to the bright and rapid motion of the aurora itself. Dr. Wilson agreed with me in this explanation, but Dr. Atkinson, Wright, and Ponting continued to hold firmly that they had really seen the aurora in the lower atmosphere this side of the mountain.

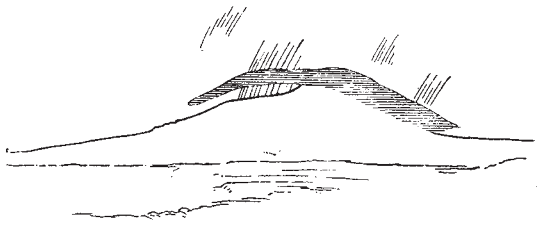

FIG. 1.

"(*b*) *June* 22, 1911.—At about 21h. 30m. Meares reported an aurora this side of Erebus. On going out to examine, I found that the effect had disappeared; the explanation, however, seemed simple. The top of Erebus was covered with a cloud-cloak, which had an external form almost like that of the mountain. At one side, however, it was incomplete, and no doubt the aurora was seen between the cloud here and the mountain. In the dim light the outline of the cloud was taken to be that of the mountain, so that the aurora appeared to be in front of the mountain. (Fig. 1.)

"(*c*) *July* 19, 1911.—At 5 a.m. Meares reported to me an aurora in front of Erebus. On going out, there appeared to be a very bright beam of aurora low down on the foothills of the mountain, and obviously

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well in front of the latter. The explanation was, however, simple. The beam was not an aurora beam at all, but part of the 22° halo with the horizontal mock moon. The illusion was, however, very striking, as there were vertical beams of aurora on the left and above the halo beam." (Fig. 2.)

I have given above the actual words written at the time, as it is dangerous to describe an observation several years later, especially if a matter of opinion is concerned. I feel compelled, however, to add a few further remarks.

With regard to (*a*), it should be realised that as the moon was low, the outlines of the mountain were very indistinct, and the bands of light due to the moon shining on the shoulders were very faint. Normally, they could scarcely be seen, but when an aurora beam above the mountain coincided with a band, the eye was guided down from the beam to the band of light, which then attracted the attention and appeared as a continuation of the aurora beam.

A cloud-cloak similar to that referred to in (*b*) was often observed to cover the top of Erebus, especially after a blizzard. It frequently lay very near to the mountain, and at night its outline would not be distinguishable from that of the mountain. It was only when the gap between the mountain and the cloud, through which the aurora appeared, was observed that the presence of the cloud itself was suspected. This was an excellent illusion, and nine casual observers out of ten would have been convinced that the aurora was clearly visible in front of the mountain.

The third illusion was probably the most impressive. The mock moon, with part of the vertical circle, was formed in a mist, itself quite invisible, which lay over the foothills of Erebus. The moon was shining in a clear sky without any sign of a halo, and none but a trained observer would have connected this detached beam of light with the moon. It appeared to be much more a part of the aurora display which was taking place apparently in its immediate neighbourhood, and the conclusion reached by Meares that it was a part of the aurora was very natural.

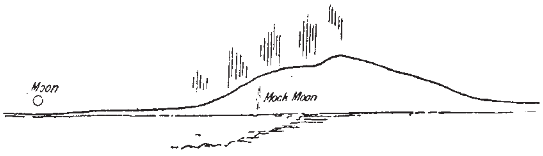

FIG. 2.

In my paper on "Atmospheric Electricity in High Latitudes" (Phil. Trans., A, vol. ccv., p. 92, 1905), I described another case of an illusion in Lapland, which made the aurora appear underneath low-lying clouds. Thus both in the north and in the south I have seen cases in which the aurora appeared to be in the lower atmosphere, and in all these cases very careful observing was necessary to discover the illusion. The mere statement, therefore, that an aurora has been seen between the observers and a near object cannot be accepted as a proof of the penetration of the aurora into the lower atmosphere.

G. C. SIMPSON.

Meteorological Office, Simla, India, June 13.

ELECTRICAL phenomena resembling aurora have hitherto been observed in the laboratory only at very low atmospheric pressures, and the recent determinations of the altitude of aurora by Prof. Störmer and others have given few heights so low as 50 km. Thus reported observations of aurora below the summits of mountains are naturally viewed with suspicion by physicists. The explanations given by Dr. Simpson of the three cases he describes—the only ones apparently observed during the Scott Antarctic Expedition of 1911–12—are ingenious. But in two cases it is not explicitly stated whether the original observer accepted the proffered explanation, and in the remaining case it appears that, with Dr. Simpson's explanation before them, the majority of the observers remained of their original opinion. Sir Douglas Mawson's list included a greater number of apparent cases of aurora at low altitudes, but whether the observers possessed the exact shade of scepticism desirable in observers in such a case I am unable to say.

My own view is that we are not as yet in a position to deny the possibility of the occurrence of aurora at low levels near the magnetic poles. It is desirable that the observers of the next Arctic or Antarctic expedition should be familiar with what has been written on the subject, and that they should be specially careful in dealing with any apparently low-level aurora. Also observation of auroral heights by photography after Prof. Störmer's method should be a fundamental part of the programme of any such expedition; and while a long base should be used for some of the observations, others should employ a base sufficiently short to deal satisfactorily with heights of only a few kilometres.

C. CHREE.

August 17.

Hybrid Sunflowers.

IN crossing the different species and varieties of Helianthus some peculiar results have been obtained. The crosses referred to have all been made by my wife at Boulder, Colorado, and the results may be classified as follows:—

(1) The varieties of *Helianthus annuus* (including *H. lenticularis*, regarded by some botanists as a distinct species) when crossed together produce plants which are as fertile as the parents. In some of the mongrel varieties there is, however, a marked deficiency of pollen.

(2) The annual species of sunflowers (typical Helianthus) crossed together are quite fertile, but the hybrids are themselves nearly sterile. *H. annuus* has been crossed with three species, *H. argophyllus*, *H. petiolaris*, and *H. cucumerifolius*.

(3) The annual species can rarely be crossed with the perennial, and when this occurs the offspring closely resemble one or the other parent species. One such hybrid was recorded in the "Standard Cyclopedia of Horticulture" (vol. vi., 1917, p. 3281) as between *H. pumilus* and *H. annuus*. Renewed study of the living plants this year convinces me that this is an error; the perennial parent was, in fact, *H. subrhomboideus*. Both species occur here, and Mrs. Cockerell, at the time of making the cross, did not distinguish between them. Morphologically they are especially distinguished by the fact that *H. subrhomboideus* has underground migratory branches, by means of which it spreads, while *H. pumilus* is strictly stationary, reproducing only by seed. The hybrid, which closely resembles *H. subrhomboideus* (though this was the pollen parent), but is much larger, with larger broad leaves, has small or short underground branches, but, nevertheless, is stationary. That is to say, the migrators are present, but the plant does not spread by them in all directions as do the true migratory forms. Comparing the details of structure, I found that the ray-florets of the hybrid were quite without pistils, whereas these were well developed (though not functional) in the *H. subrhomboideus*. However, further investigation showed, to my surprise, that some heads of the wild *H. subrhomboideus* had the ray-florets wholly without pistils. The involu-

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